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Technology Challenges for Obtaining Sub-Mas Angular Resolution UV/Optical Spectral Imaging Observations

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We describe the major technology development efforts that need to occur throughout the 2010's and 2020's in order to enable a wide variety of future sparse aperture and interferometric missions. These missions are critical to achieving the next major revolution in astronomical observations by dramatically increasing the achievable angular resolution by more than 2 orders of magnitude, over wavelengths stretching from the x-ray into the sub-mm. These observations can only be provided by such missions, since the aperture diameters required are in excess of 500m - a regime in which monolithic or segmented designs are not and will not be feasible - and since they require observations at wavelengths not accessible from the ground. Examples of such proposed missions include: Stellar Imager (SI), Luciola (ESA concept), Life Finder (LF), Black Hole Imager (BHI), and Planet Imager (PI), as well as smaller precursor missions using one or more of the technologies, such as the Fourier Kelvin Stellar Interferometer (FKSI), a space interferometry Pathfinder mission, selected Exo-Planet Probes, and ESA's Pegase. The technology developments needed for these missions are challenging, but eminently feasible with a reasonable investment over the next decade, especially if we build on the existing substantial ground-based capabilities, to enable flight in the 2025+ timeframe. *That investment would enable tremendous gains in our understanding of the structure of the Universe and of its individual components in ways both anticipated and unimaginable today*. The major technology challenges (and approximate Technology Readiness Levels) to building such missions are shown in Table 1 and a notional development flow, with very approximate dates, is shown in Figure 1.

Table 1: Technologies Needed to Enable Space Interferometry	TRL now
Methodologies for ground-based I&T of distributed systems	2
Precision Aspect Control	3
Long Baseline Precision Metrology	3
Lightweight, UV-quality (for SI) mirrors with km-long radii of curvature	3
Precision Formation Flying of large arrays	3-4
Wavefront Sensing & Control and Closed-Loop optical path control of many-element sparse arrays	4
Mass-production of spacecraft ("mirrorsats" for the primary array)	4
Methodologies for combining up to 20-30 simultaneous beams	4
Variable, non-condensing μN thrusters	4

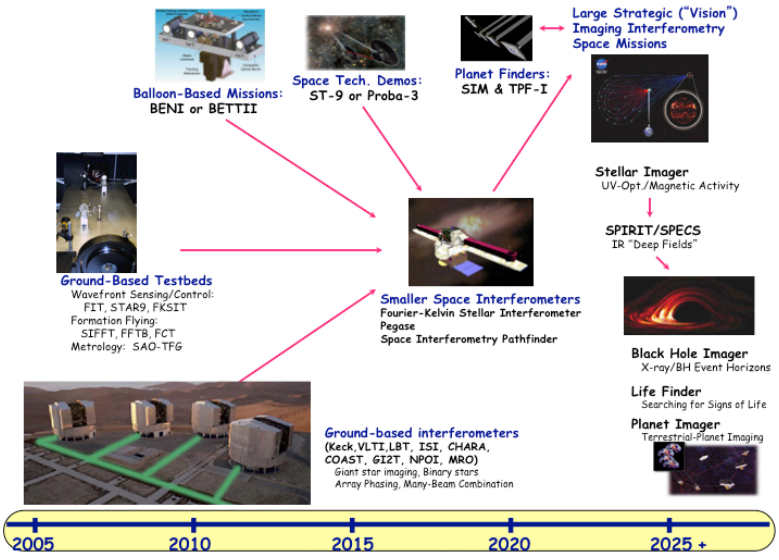

Figure 1: A notional development flow for Space Interferometry